Columbia/Snake Rivers Temperature TMDL
Preliminary Draft September 13, 2002

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Executive Summary

Description of Waterbody, Pollutant of Concern, and Pollutant Sources

This Total Maximum Daily Load (TMDL) addresses water temperature in the mainstem segments of the Columbia River from the Canadian Border (River Mile 745) to the Pacific Ocean and the Snake River from its confluence with the Salmon River (River Mile 188) to its confluence with the Columbia River. The States of Oregon and Washington and the U.S. Environmental Protection Agency (EPA) have listed multiple segments of both mainstem reaches on their federal Clean Water Act (CWA) 303(d) lists due to water temperatures that exceed state water quality standards (WQS). The entire reaches of both rivers are considered impaired for water temperature. EPA is establishing this TMDL for waters within the States of Oregon and Washington and within the Reservations of the Confederated Tribes of the Colville Reservation and the Spokane Tribe of Indians. At this time, the Idaho Department of Environmental Quality is anticipating simultaneously issuing the TMDL for waters within the jurisdiction of the State of Idaho.

Water temperature can be elevated above natural conditions by a number of human activities. The primary sources of elevated temperatures in the Columbia and Snake Rivers are point sources, nonpoint sources, and dams. Point sources discharge thermal energy directly to the river. Nonpoint sources such as agricultural run off discharge to the rivers primarily via irrigation canals and tributaries. Dams alter river temperature by changing the flow regime, stream geometry, current velocity and flood plain interactions of the river.

The effects of point sources and tributaries (nonpoint sources) on cross sectional average water temperatures in the main stems are for the most part quite small. The point sources can cause temperature plumes in the near-field but they do not result in measurable increases to the cross-sectional average temperature of the main stems. That is, the cumulative impact of all the point sources is less than 0.14 °C when temperature criteria are exceeded in the river. Some of the dams, however, do cause measurable changes in the cross-sectional average temperature of the main stems. They increase the cross-sectional average temperature and they extend the period of time during which the water temperature exceeds numeric temperature criteria. The impact to water temperature of the dams ranges from very small at Priest Rapids where the maximum impact is about 0.09 °C to the impact of Grand Coulee which is as high as 6.0 °C in the late fall. Eight of the 15 dams have maximum impacts to temperature of over 0.5 °C.

Description of the Applicable Water Quality Standards and Numeric Targets

The WQS for temperature on the Columbia and Snake Rivers are quite complex. The three states and one tribe with EPA-approved standards have adopted a variety of numeric and narrative criteria for temperature in the segments of the Columbia/Snake mainstems within their jurisdictions. A common component in all of the standards is a provision to account for times when natural water temperatures in the rivers exceed numeric water quality criteria. Generally,

when this occurs, the standards allow small incremental increases to the natural temperatures. Washington WQS, which apply to all of the TMDL project area except the upper 12 miles of the Snake River reach, also restrict incremental increases in temperature when the natural temperature is below numeric criteria. The TMDL is based on the most stringent standards that apply on the rivers reach by reach. Table S-1 summarizes the WQS standards that are the basis for this TMDL.

Table S-1: Summary of Water Quality Standards that Apply to the Columbia and Snake Rivers

Columbia River Reach	**Criterion**	**Natural Temp < Criterion**	**Natural Temp > Criterion**
Canadian Border to Grand Coulee Dam	16 °C DM	Natural + 23/(T+5)	Natural + 0.3 °C
Grand Coulee Dam to Chief Joseph Dam	16 °C DM	Natural + 23/(T+5)	Natural + 0.3 °C
Chief Joseph Dam to Priest Rapids Dam	18 °C DM	Natural + 28/(T+7)	Natural + 0.3 °C
Priest Rapids Dam to Oregon Border	20 °C DM	Natural + 34/(T+9)	Natural + 0.3 °C
Oregon Border to mouth	12.8/20 °C DM	Natural + 1.1 °C	Natural + 0.14°C
Snake River Reach	**Criterion**	**Natural Temp < Criterion**	**Natural Temp > Criterion**
Salmon River to OR/WA Border	12.8/17.8 °C 7DADM	Up to Criterion	Natural + 0.14 °C
OR/WA Border to ID/WA Border	20 °C DM	Natural + 1.1 °C	Natural + 0.3 °C
ID/WA Border to Mouth	20 °C DM	Natural + 34/(T+9)	Natural + 0.3 °C

T = the background temperature as measured at a point or points unaffected by the discharge and representative of the highest ambient water temperature in the vicinity of the discharge.
DM = daily maximum temperature.
7DADM = seven day average of the daily maximum temperatures..

Development of the target temperatures for the TMDL depends on an understanding of natural temperature. A mathematical water quality model was used to simulate temperature conditions in the mainstems of the Columbia and Snake Rivers in the absence of human activity in the mainstems. The simulations utilize existing flow and temperature in the tributaries and at the TMDL boundaries. These simulated temperatures are an approximation of natural conditions because they do not account for possible impacts from altered water temperature and flow regimes outside the TMDL project area. To maintain the distinction from purely natural temperatures, these simulated temperatures are referred to as site potential temperatures. This TMDL is based on the site potential temperatures; the temperatures that are estimated to occur in

the absence of human activity in the mainstems.

The site potential temperatures in the mainstems vary considerably throughout the year, from year to year, and longitudinally along the rivers. To account for the temporal variation, the site potential temperatures are simulated using a thirty year data record and the target temperatures for the TMDL are expressed as thirty year mean temperatures for every day of the year. To account for the spatial variation, the rivers are divided into 21 longitudinal reaches with a TMDL Target Site at the down river end of each reach.

The mathematical model has been used to evaluate cumulative impacts of upstream temperature impacts on downstream segments of the TMDL. This analysis indicates that elevating temperatures of upstream segments to the degree allowed under the WQS (Table S-1) would result in exceedances of WQS in downstream segments. As a result, the target temperatures in the lower reach of the Columbia River drive the upstream allocations for this TMDL. Therefore, the target temperatures of each reach above the Oregon/Washington Border are lower than those indicated by Table S-1. The targets at each upper reach are lowered enough to ensure that the target temperature in the downstream reach are achieved. Figure S-1 illustrates the existing temperature and the TMDL target temperature at the John Day target site.

Application of the Target Temperatures

The target temperatures for this TMDL are expressed as daily cross sectional average temperatures. The cross sectional average temperature is representative of the free flowing river because it was generally well mixed. The target temperature must be achieved as a daily cross sectional average in the impounded river but also throughout the width and depth of the thalweg, in critical fish habitat and in fish ladders and holding facilities.

Loading Capacity

The loading capacity is expressed as temperature rather than as thermal load. The regulations governing TMDL development provide for the expression of TMDLs as "either mass per time, toxicity, or other appropriate measure" (40CFR130.2(h)). Temperature is an appropriate measure in this TMDL because dams play a major role in altering the temperature regime of the river but they do not discharge water bearing a thermal load to the river. Dams alter the temperature regime of the river by altering the stream geometry and current velocity upstream of the dam. Expressing the loading capacity and allocations as temperatures addresses a potential concern that dam operators could choose to alter flow in the river to achieve thermal load targets without improving temperature. In this TMDL, the loading capacity is the daily target temperature at River Mile 4 of the Columbia River as depicted in Figure 5-1 and in Appendix B.

Pollutant Allocations (see Table S-2)

The load available for allocation is the temperature increment over the natural or site

potential temperature allowed under the WQS. For example at the furthest downstream point in the river, this increment is 0.14 °C when numeric criteria are exceeded and 1.1 °C the rest of the time. Much of this temperature increment is consumed by the allocations to the point sources as wasteload allocations (WLA). In the WLA, the load each point source can discharge to the river is expressed as megawatts (MW). There are 106 Point Sources with individual NPDES permits in this TMDL. All but 11 of these point sources have only a minimal effect on mainstem temperatures (defined for the purpose of this TMDL as less than 0.014 °C). These 95 smaller point sources are included in group allocations for each reach. The 11 larger point source dischargers receive individual allocations.

EPA, Oregon and Washington have issued 27 general NPDES permits. Currently 16 of them have a total of 96 permittees that discharge to the Columbia or Snake Rivers. The contribution to temperature from the sources covered by the general permits is minimal; especially when compared to the temperature loads from large point sources and the impacts of the dams. An additional 20 megawatts is added to each group allocation to account for these sources.

Since the site potential simulations incorporate existing tributary temperatures, none of the temperature increment is allocated to tributaries. All tributaries are allocated their existing loads.

The temperature increment remaining to be allocated after allocation to the point sources is very small and therefore, the temperature increase allocated to the 15 dams is also very small: 0.1 °C for each dam except Priest Rapids Dam which is allocated 0.09 °C.

Margin of Safety

Implicit margins of safety have been built into the TMDL. For point sources the WLA is based on reasonable worst case discharges. Further, the wasteload allocation for point sources does not vary with flow. It achieves water quality standards at the 7Q10 low flow, thereby providing a margin of safety when flows are greater than the 7Q10. For dams, the use of daily average temperatures (as opposed to maximum temperatures only) is a conservative application of the WQS provisions regarding natural temperature conditions.

Seasonal Variation

Temperature varies seasonally along the rivers. Generally, both rivers exceed water quality criteria during the summer along their entire lengths. Since the WQS are tied to natural conditions, they vary throughout the year, changing with the seasons. Seasonal variation was incorporated into the temperature TMDL by establishing targets for each day of the year to account for changes in the site potential throughout the year.

Future Growth

A small portion of the available temperature increases has been allocated to future growth in the group allocations. Twenty MW of heat energy have been added to each group above that needed by the dischargers in the group.

Monitoring Plan

Long term, system wide effectiveness of TMDL implementation activities can be assessed by monitoring mainstem river temperatures at the target sites. Over the long term, if implementation is adequate, the daily mean temperatures at the target site should equal the 30 year mean target temperatures at those sites. Individual years may exceed those temperatures because of natural variation.

Short term monitoring for compliance with WLAs will be accomplished through effluent monitoring by the point sources. For individual dams, one option for short term monitoring is to evaluate the temperature difference between successive dams. The TMDL includes curves showing the temperature differences for existing conditions and for the conditions of the implemented TMDL. Effectiveness of TMDL implementation within individual impoundments can be determined by comparison of actual temperature differences between dams to the TMDL curves.

Implementation Plans

Implementation plans will be developed by the States and Tribes.

Public Participation

Extensive public involvement activities, organized by the inter-agency TMDL Coordination Team have occurred for this TMDL over the past two years. Activities have included websites, fact sheets, coordination meeting, individual meetings with interested groups, nine public workshops and numerous conference presentations. Public participation efforts will continue until the TMDL is finalized. Three public workshops are planned to review the preliminary draft TMDL and public meetings with the opportunity for public comment will be held during the draft TMDL comment period.

Table S-2: Summary of the Columbia/Snake River TMDL, showing gross allocations for each river reach and individual wasteload or load allocation for each facility in every reach.

River Reach / Facility	Temperature Increase Allowed Within Each Reach	Wasteload Allocation	Load Allocation
COLUMBIA RIVER FACILITIES			
International Border to Grand Coulee	**.0109 °C**	**0.0009 °C**	**0.01 °C**
Group		21.37 MW	
Grand Coulee Dam			0.01 °C
Grand Coulee to Chief Joseph	**.0109 °C**	**0.0009 °C**	**0.01 °C**
Group		24.53 MW	
Chief Joseph Dam			0.01 °C
Chief Joseph to Wells	**.0105 °C**	**0.0005 °C**	**0.01 °C**
Group		23.78 MW	
Wells Dam			0.01 °C
Wells to Rocky Reach	**.0106 °C**	**0.0006 °C**	**0.01 °C**
Group		28.01 MW	
Rocky Reach Dam			0.01 °C
Rocky Reach to Rock Island	**0.0109 °C**	**0.009 °C**	**0.01 °C**
Group		90.80 MW	
Rock Island Dam			0.01 °C

River Reach / Facility	**Temperature Increase Allowed Within Each Reach**	**Wasteload Allocation**	**Load Allocation**
Rock Island to Wanapum	**.0104 °C**	**0.0004 °C**	**0.01 °C**
Group		20.46 MW	
Wanapum Dam			0.01 °C
Wanapum to Priest Rapids	**.0904 °C**	**0.0004 °C**	**0.09 °C**
Group		20.0 MW	
Priest Rapids Dam			0.09 °C
Priest Rapids to McNary	**.029 °C**	**0.019 °C**	**0.01 °C**
Group		244.13 MW	
Agrium Bowles Road		206.8 MW	
Agrium Game Farm Road		384.5 MW	
Boise Cascade Walulla		200.1 MW	
McNary Dam			0.01 °C
McNary to John Day	**.0108 °C**	**0.0008 °C**	**0.01 °C**
Group		59.81 MW	
John Day Dam			0.01 °C
John Day to The Dalles	**.0102 °C**	**0.0002 °C**	**0.01 °C**
Group		20.73 MW	

The Dalles Dam			0.01 °C
River Reach / Facility	**Temperature Increase Allowed Within Each Reach**	**Wasteload Allocation**	**Load Allocation**
The Dalles to Bonneville	**.0115 °C**	**0.0015 °C**	**0.01 °C**
Group		99.07 MW	
Bonneville Dam			0.0 °C
Bonneville to River Mile 112	**.008 °C**	**.008°C**	**0.0 °C**
Group		163.27 MW	
Fort James Camas		337.8 MW	
River Mile 112 to River Mile 95	**0.005 °C**	**.005 °C**	**0.0 °C**
Group		926.3 MW	
River Mile 95 to River Mile 72	**0.027 °C**	**0.027 °C**	**0.0 °C**
Group		42.84 MW	
Boise/ St.Helens		219.56 MW	
Coastal St. Helens		365.09 MW	
PGE Trojan		511.15 MW	
River Reach / Facility	**Temperature Increase Allowed Within Each Reach**	**Wasteload Allocation**	**Load Allocation**
River Mile 72 to River Mile 42	**0.025 °C**	**0.025 °C**	**0.0 °C**

Group		224.87 MW	
Longview Fiber		455.4 MW	
Weyerhouser Longview		338.7 MW	
GP Wauna		301.71 MW	
River Mile 42 to River Mile 4	**0.0004 °C**	**0.0004 °C**	**0.0 °C**
Group		46.79	
River Mile 4 to River Mile 0	**0.00005 °C**	**0.00005 °C**	**0.0 °C**
Group		26.28	
River Reach / Facility	**Temperature Increase Allowed Within Each Reach**	**Wasteload Allocation**	**Load Allocation**
SNAKE RIVER FACILITIES			
Salmon River to River Mile 138	**0.04 °C**	**0.04 °C**	**0.0 °C**
Group		**30.28 MW**	
Potlatch		298.76 MW	
River Mile 138 to Lower Granite	**0.011 °C**	**0.001 °C**	**0.01 °C**
Group		20.0 MW	
Lower Granite Dam			0.01 °C
Lower Granite to Little Goose	**0.011 °C**	**0.001 °C**	**0.01 °C**
Group		20.02 MW	

Little Goose Dam			0.01 °C
Little Goose to Lower Monumental	**0.011 °C**	**0.001 °C**	**0.01 °C**
Group		21.39 MW	
Lower Monumental Dam			0.01 °C
Lower Monumental to Ice Harbor	**0.011 °C**	**0.001 °C**	**0.01 °C**
Group		20.004 MW	
Ice Harbor Dam			0.01 °C
Ice Harbor to River Mile 0	**0.001 °C**	**0.001 °C**	**0.0 °C**
Group		20.004 MW	

1.0 Introduction

Scope of this TMDL

The scope of this TMDL is water temperature in the main stem segments of the Columbia River from the Canadian Border (River Mile 745) to the Pacific Ocean and the Snake River from its confluence with the Salmon River (River Mile 188) to its confluence with the Columbia River (see Figure 1-1). Table 1-1 summarizes the portions of the two rivers listed as impaired for temperature pursuant to Section 303(d) of the Clean Water Act. EPA listed the Snake River from the Salmon River to the Washington/Idaho Border on the Idaho 1998 Section 303(d) list (EPA, 2001). Oregon included the entire Oregon portions of the Snake and Columbia rivers on its 1998 Section 303(d) list (Oregon DEQ, 1998). Washington included 26 different segments of the two rivers on its 1998 Section 303 list (Washington DOE, 1998). In a letter dated September 4, 2001, Washington clarified that "...much or all of the mainstem Columbia and Snake Rivers violate water quality standards for temperature..." and that the entire lengths of the Columbia and Snake rivers should be addressed in the temperature TMDL (Washington DOE, 2001). This TMDL addresses dams, point sources and non-point sources of thermal loading to the main stems themselves. There are 15 dams, as well as 106 point sources regulated by individual National Pollutant Discharge Elimination System (NPDES) permits, on the two main stems addressed by this TMDL. There are also 27 general NPDES permits that currently regulate 96 facilities on the Snake and Columbia rivers. The thermal loadings from non-point sources enter the main stems primarily through tributaries and irrigation return flows. There are 193 tributaries including seven significant irrigation flows addressed in this TMDL.

Legal Authority

Under authority of the Clean Water Act, 33 U.S.C. § 1251 et seq., as amended by the Water Quality Act of 1987, P.L. 100-4, the U.S. Environmental Protection Agency is establishing a Total Maximum Daily Load (TMDL) for temperature in the main stems of the Columbia River from the Canadian Border to the Pacific Ocean and the Snake River from its confluence with the Salmon River to its confluence with the Columbia River. EPA is establishing the TMDL for waters within the states of Washington and Oregon and waters within the reservations of the Confederated Tribes of the Colville Reservation and the Spokane Tribe of Indians. At this time, the Idaho Department of Environmental Quality is anticipating simultaneously issuing the TMDL for waters within the jurisdiction of the State of Idaho.

The States of Oregon, Washington and Idaho worked with EPA in coordination with the thirteen tribes of the Columbia Basin to develop this inter-jurisdictional TMDL for the Columbia and Snake River main stems. The Oregon Department of Environmental Quality requested in writing (Oregon DEQ, 2001) that EPA establish the TMDL in the State of Oregon. The Department cited the interstate nature of the waterway, EPA's development of the temperature model, RBM 10, and the Department's lack of resources as the reasons for its request. The request was made pursuant to Section X of the TMDL Memorandum of Agreement between